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Patentanmeldung Nr. Patent application No. Demande de brevet n°

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Record carrier with protective linking areas

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Field of the invention

The invention concerns any record carrier intended to store data that are susceptible to be copied. The invention relates to the protection of original data stored on an original pre-recorded record carrier. The invention relates also to the control of the compatibility of rewritable (and writable) record carriers of different standards. Record carriers concerned are, for example, optical discs.

Background of the Invention

During normal copying, the writing of copied data on such a writable record carrier uses re-encoding of data in such a way that data are locked to a physical sector number related to the wobbled groove of the writable record carrier. The problem of the protection of data that are susceptible to be copied on a writable disc is known from document EP0899733. In this document is proposed the implementation of a copy prevention method during the manufacturing of an optical record carrier by modifying subcode address information of a predetermined pattern of blocks. It is normally not possible to copy incorrect address data onto an optical record carrier, since the address data will be newly generated during the copy process. Such modified subcode address information, called a hidden key, is thus utilized to distinguish between an original record carrier and a copied or non-original record carrier. As the prevention method is implemented during manufacturing, it can be used to encrypt data stored on the record carrier. Such hidden keys can thus be hidden in order that normal copying, by applying first demodulation/decoding followed by re-encoding of the data, destroys the hidden keys and renders the copy unplayable. Nevertheless, a bit-by-bit copy consists of copying data from an original classical record carrier without any decoding/re-encoding. Data are then copied as-it-is and although the bit errors present on the disc are also copied, the copy method enables the transfer of the hidden-keys present in the format for the purpose of copy protection. Consequently bit-by-bit copying is a method to get around some copy protection measures like such a hidden channel key on an original record carrier.

Summary of the Invention

It is an object of the present invention to propose a record carrier that allows to protect the stored data from being bit-by-bit copied to a writable record carrier.

To this end, the invention proposes a record carrier characterized in that data are intended to be stored according to a standard, implementing physical data clusters separated by protective linking areas, said protective linking areas being of different size from linking areas of a writable record carrier intended to store data locked to a pre-recorded wobbled groove using linking areas.

For example, in Blu-ray Disc rewritable record carriers, address unit numbers of physical data clusters are conventionally linked to wobble addresses. Said address unit numbers are

stored in the data format, for instance in the heavily protected BIS columns of physical clusters in the Blu-ray Disc (BD) format. A physical cluster is delimitated by two linking areas.

Such linking areas are used to create margins for the purpose of replacing isolated physical clusters. Thus physical data clusters containing stored data are locked to their absolute position on the disc by linking the address unit numbers to the wobble addresses of the pre-recorded wobbled groove. This allows also to have a fast localization on the writable record carrier. Said linking areas have a specific standardized size for each standard of (re-) writable record carrier.

Readers demand for a coupling between the wobble address and the address unit number in order to realize the reading of such a (re-)writable disc.

By including protective linking areas of different size on a record carrier intended to store data that need to be protected from a copy on a writable record carrier, it is avoided that a bit-by-bit copy will allow a good copy of said record carrier. Effectively a bit-by-bit copy will imply that the physical data clusters on the (re-)writable record carrier are no more aligned with the wobble addresses. As a direct consequence, the writable record carrier will not be correctly playable.

According to an advantageous embodiment, said protective linking areas of said record carrier are shorter than the linking areas of the writable record carrier.

According to a preferred embodiment, said protective linking areas of said record carrier are longer than linking areas of the (re-)writable record carrier and essential data for playability of said record carrier are stored in the protective linking areas of said record carrier.

In a first application, said record carrier is another (re-)writable record carrier of a different standard. In such an application, the invention enables to control the compatibility of several standards intended to store data of a same logical format meaning generally belonging to the same family of standards. That can be a commercially valuable feature. Such standards can be the Blue-ray standard, or the Small Form Factor Optical disc (SFFO) standard. Particularly rewritable standards are concerned by the invention, as the issue of a random writing is essential.

In a second application, said record carrier is a pre-recorded record carrier including original data. In such an application, said original data are generally pre-recorded data that are distributed by a content owner.

The invention is advantageously combined with a hidden key protection. Normal copying by using de- and encoding of the data is not useful because it destroys the hidden key as bit-by-bit copy leads to an unreadable record carrier.

Brief Description of the Drawings

The invention is described hereafter in detail in reference to the diagrammatic figures wherein:

Fig.1a presents a recording unit block as classically implemented in writable record carrier intended to store data locked to a pre-recorded wobbled groove using linking areas;

Fig.1b illustrates a recording unit block as implemented in a record carrier according to the invention;

Fig.2 illustrates the functioning of the invention by illustrating a bit-by-bit copying of a record carrier according to an advantageous embodiment of the invention on a (re-)writable record carrier according to the invention;

Fig.3 illustrates the functioning of the invention by illustrating a bit-by-bit copying of a record carrier according to a preferred embodiment of the invention on a writable record carrier according to the invention;

Fig.4 is a block diagram of a method and an apparatus to manufacture a record carrier according to the invention.

Description of embodiments

Fig.1a presents a recording unit block RUB as classically implemented in writable record carrier intended to store data locked to a pre-recorded wobbled groove WOB using linking areas. The information represented by the pre-recorded wobbled groove is commonly referred as "absolute time in the pre-groove" (ATIP) or as "addresses in the pre-groove" (ADIP) depending on the standard used. ADIP data contains synchronization information and addresses linked to the physical data as well as sectors information about the disc velocity, write strategy and disc type.

In the example of Blu-Ray disc one recording unit block RUB is linked to 3 ADIP words. One ADIP word comprises 19 + 5 bits address information e.g. a physical ADIP address. Each ADIP word thus contains one address of 24 bits. One ADIP word comprises 83 ADIP units and one ADIP unit is linked to 2 recording frames that include data. One ADIP unit contains 56 Nominal Wobble Lenghts NWL. Within these 56 NWL, at some positions, wobble periods can be altered from the nominal wobbling. An altered wobble is called a Modulated Mark (MM). A Modulated Mark MM is 3 Nominal Wobble Lengths NWL long. By inserting MM's into the 56 NWL's of an ADIP unit with unique distances between adjacent MM's, different types of ADIP units can be created. In such a way the ADIP units can be used to represent different symbols, like "1" and "0" and "sync"-structures. Modulated Marks MM are formed using a Minimum Shift Keying – cosine variant modulation method and Harmonic Modulated Wave modulation method.

The ADIP units can then be used as basic unit for the address format as they can represent sync structures, and data bits... By combining the ADIP units in ADIP words the

data format for the address is set. So there are 3 addresses per Recording Unit Block. The wobbled groove WOB is modulated along the track by ADIP words allowing the localization on the disc. On figure 1a, a specific modulation WA allowing to determine a wobble address is schematically represented. In a (re-)writable record carrier intended to store data locked to a pre-recorded wobbled groove WOB using linking areas, a fixed given amount of data to be stored is formatted by a recording apparatus in physical clusters PHC. Such a physical cluster PHC includes data in a logical format that is defined by the standard of the writable record carrier concerned by the invention. Then, said recording apparatus prepares recording unit blocks RUB, each consisting of a data run-in RIN, a physical cluster PHC and a data run-out ROUT. A linking area LA is constituted by the assembly of a run-out ROUT and of a run-in RIN between two consecutive recorded physical clusters PHC.

The role and content of said run-in RIN and run-out ROUT will be explained in the following. Standards of writable record carrier are often random access formats. Consequently, localization on the record carrier needs to be fast and easy. Moreover it is necessary that each recording unit block RUB can be read separately from the others. Thus, some specific patterns are written in said linking area to aid signal processing. This is a first function of said run-in RIN and run-out ROUT that constitute said linking areas. Linking areas are also created to prevent overlap in the user data area present in the physical cluster PHC of the RUB during writing.

For example, as illustrated on figure 2a, the run-in RIN starts with a band GUARD1 which contains some specific sequences which are well suited to reset electronic circuits before locking and synchronisation occurs to read the next RUB. Also, in the Run-in there is a field PRA (after GUARD1) which serves for locking and synchronization of the signal processing.

Then the reading of the next recording unit block RUB is prepared. After reading the recording unit block RUB there is a run-out ROUT with a field POA that is used by the signal processing as illustrated on figure 2b. The end of data of that previous recording unit block RUB is thus indicated. Then the run-out ROUT includes a band GUARD2 that contains a specific sequence. Said band GUARD2 is continued in the band GUARD1 of the run-in RIN of the next recording unit block RUB.

Fig. 1b presents a recording unit block RUBB for a record carrier of the invention. According to the invention, as described in figure 1b, protective linking areas PLA are thus inserted on the record carrier of the invention and such protective linking areas PLA are of a different size from the size of linking areas LA of a writable record carrier on which the copy could occur. Here on figure 1b, RIN is smaller on the record carrier of the invention than on the writable record carrier as illustrated on figure 1a.

A record carrier of the invention can be a (re-)writable record carrier of a different format but susceptible to store data in the same logical format. In this case, the presence of linking areas PLA is necessary. A record carrier of the invention can also be a pre-recorded record carrier. In this case, the linking area PLA has no function. Generally the read-out is continuous. Nevertheless for standard consistency with (re-)writable record carrier it can be useful to insert some linking area in such pre-recorded record carrier. Said run-in RIN of a record carrier of the invention can contain data similar to the ones present in run-in RIN of the writable record carrier or data of different nature. Some possibilities are presented in the following. For example, run-in RIN and run-out ROUT of a record carrier of the invention can contain information like a copy of different addresses that allows to locate recording unit block RUB. This can be useful for fast access to stored data.

The effects of the invention on a bit-by-bit copy are illustrated on figure 3 and 4. On both figures, bit-by-bit copying, illustrated by arrows, results in non-alignment between the wobble address WA and the recording unit block RUBB. As a consequence the copy cannot be played. It has to be noted that these figureS are schematic and that, for example, in Blu-Ray format, the wobble address occupies a large part of the ADIP words and not only a small part WA at the start of the ADIP words. The non-alignment is consequently present all along the wobble.

On figures 3 and 4, the effect of the non-alignment will integrate. After several recording unit blocks RUBB, all recording unit blocks RUBB are totally 'covered' with wrong ADIP addresses. The exact number after which a total wrong covering is obtained is depending of difference between the lengths of linking areas of writable record carrier and protective areas of the record carrier of the invention.

On figure 3, the size of the protective linking areas PLA between two recording unit blocks RUBB of a record carrier of the invention is shorter than the size of linking areas LA between two recording unit blocks RUBB of a writable record carrier. A non-alignment of the wobble address WA with the RIN and ROUT of two successive recording unit block RUBB is observed. The copied record carrier cannot be played correctly. Nevertheless, if there is no additional protection by hidden key, normal copy by decoding/encoding, can be successful. It is effectively possible to decode data read on the record carrier of the invention even if said linking areas are of different size. If there is no additional protection means (for example by hidden key), the re-encoding allows to successfully copy the record carrier.

On figure 4, the size of the protective linking areas PLA between two recording unit blocks RUBB of a record carrier of the invention is longer than the linking areas LA of the writable record carrier. A non-alignment is also observed in such an embodiment.

Moreover, in this case, it is possible to fill in said protective linking areas PLA with essential data ED, especially in the supplementary part that is called extension part. Such essential data ED can be information for copy protection. A protection key can also be stored in such protective linking areas PLA. Information needed by an application to which are dedicated data stored in the physical cluster PHC can also be stored advantageously in such longer protective linking areas PLA. Thus a hacker cannot shorten the protective linking areas PLA to the size of the linking areas LA of the writable record carrier even with a decoding/re-encoding and information is lost in dashed areas LST. Thus, according to the invention, it is possible to prevent the bit-by-bit copying but also the normal copying. Effectively, in general, it is wanted that copy protection information should be at least as robust or more robust than the main data but it is possible that copy protection information present in the extension part of said protective linking areas have less robustness than main data.

In figures 3 and 4, the case of a copy of a pre-recorded record carrier has been more studied. In the application of the invention to a (re-)writable standard record carrier intended to store data in the same logical format, the writable record carrier of the invention will have a wobbled groove adapted to the size of said protective linking areas PLA. Linking areas are advantageously a multiple of the size of the ADIP unit. Thus, for example, a (re-)writable record carrier of the invention has protective linking areas PLA of the length of a single ADIP unit, the original (re-)writable record carrier has linking areas LA of the length of two ADIP unit. The invention then also allows to control the compatibility between different standards belonging to the same format family, meaning the same logical data format.

Figure 5 is a schematic diagram of a recording apparatus allowing to manufacture a pre-recorded record carrier according to the invention RDSC. This figure is also illustrative of a method to manufacture a pre-recorded record carrier RDSC of the invention from a blank record carrier BDSC.

Data DAT to be stored are provided to an encoder ENC as well as a content for said protective linking areas PLA. Said content is such that the protective linking areas PLA are of different size than the size of linking areas LA of writable record carrier of a standard on which copy need to be avoided. The encoder ENC then prepare the recording unit block RUBB that are provided to an optical head unit OHU that includes means for irradiating said blank record carrier BDSC with light. A pre-recorded record carrier according to the invention has protective linking areas PLA of a different size than the ones of a writable record carrier susceptible to store data copied from said pre-recorded record carrier.

A writable record carrier of the invention is obtained by forming a wobbled groove in coherence with said protective linking areas PLA. Any apparatus to manufacture wobbled grooved record carrier can be used to manufacture a writable record carrier of the invention.

Presented figures are illustrative of a special embodiment of the invention and are not restrictive. The invention is a generic solution to prevent bit-by-bit copying for data-wobble locked format.

It will be apparent to those skilled in the art that many modifications and variations may be made to the exemplar embodiments of the present invention set forth above, without departing substantially from the principles of the present invention. All such modifications and variations are intended to be included herein.

Claims:

1. A record carrier intended to store data characterized in that data are intended to be stored according to a standard implementing physical data clusters separated by protective linking areas, said protective linking areas being of different size from linking areas of a writable record carrier intended to store said physical data clusters locked to a pre-recorded wobbled groove using linking areas.

2. A record carrier as claimed in Claim 1, wherein said record carrier is an optical disc.

3. A record carrier as claimed in one of the Claims 1 and 2, wherein said protective linking areas of said record carrier are shorter than linking areas of the writable record carrier.

4. A record carrier as claimed in one of the Claims 1 and 2, wherein said protective linking areas of said record carrier are longer than linking areas of the writable record carrier, essential data for playability of said record carrier being stored in said protective linking areas of said record carrier.

5. A record carrier as claimed in one of the Claims 1 to 4, wherein said record carrier is another writable record carrier of a different standard.

6. A record carrier as claimed in one of the Claims 1 to 5, wherein said record carrier is a pre-recorded record carrier including original data.

7. A record carrier as claimed in one of the Claims 1 to 6, wherein said record carrier implements also a protection using a hidden key.

8. A pre-recorded record carrier manufacturing apparatus, characterized in that said apparatus includes means to form recording unit blocks including protective linking areas between physical clusters of data, said linking areas being of different size from linking areas of a (re-)writable record carrier intended to store said physical data clusters locked to a pre-recorded wobbled groove using linking areas.

9. A pre-recorded record carrier manufacturing method, characterized in that said method includes the step of forming recording unit blocks including protective linking areas between

physical clusters of data, said linking areas being of different size from linking areas of a writable record carrier intended to store said physical data clusters locked to a pre-recorded wobbled groove using linking areas.

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"Record carrier with protective linking areas."

Abstract:

The invention relates to a record carrier intended to store data. According to the invention data are intended to be stored according to a standard implementing physical data clusters separated by protective linking areas, said protective linking areas being of different size from linking areas of a writable record carrier intended to store said physical data clusters locked to a pre-recorded wobbled groove using linking areas.

The invention enables to avoid bit-by-bit copy of said record carrier on said writable record carrier. The invention can also allow to control the compatibility of different standards of writable record carrier.

Application: Optical storage.

FIG. 3

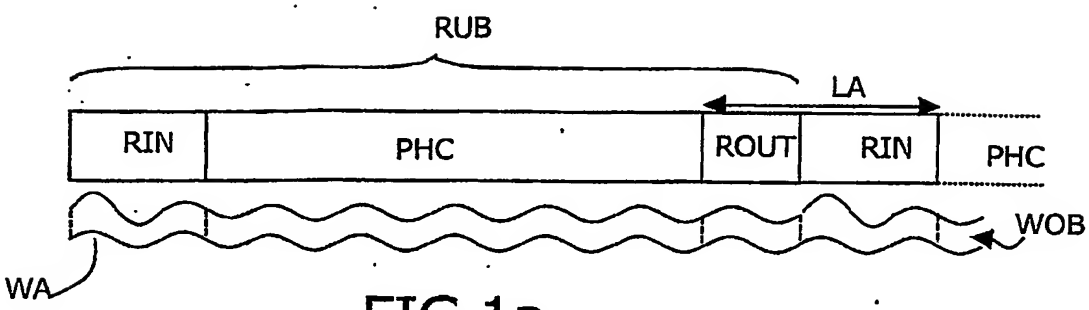

FIG.1a

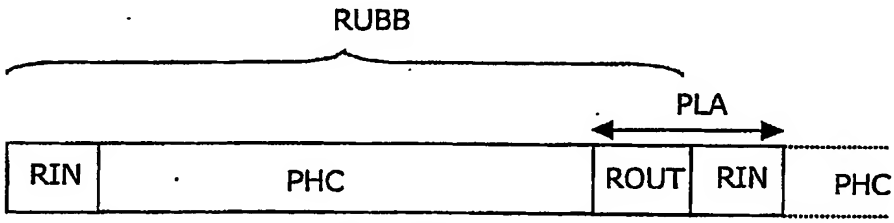

FIG.1b

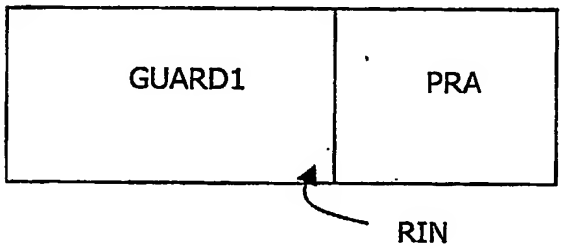

FIG.2a

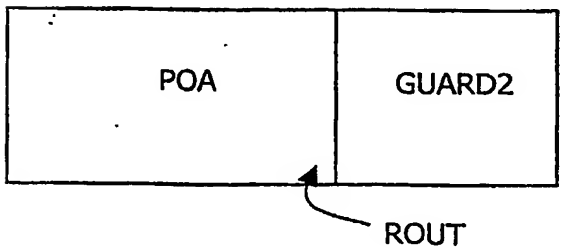

FIG.2b

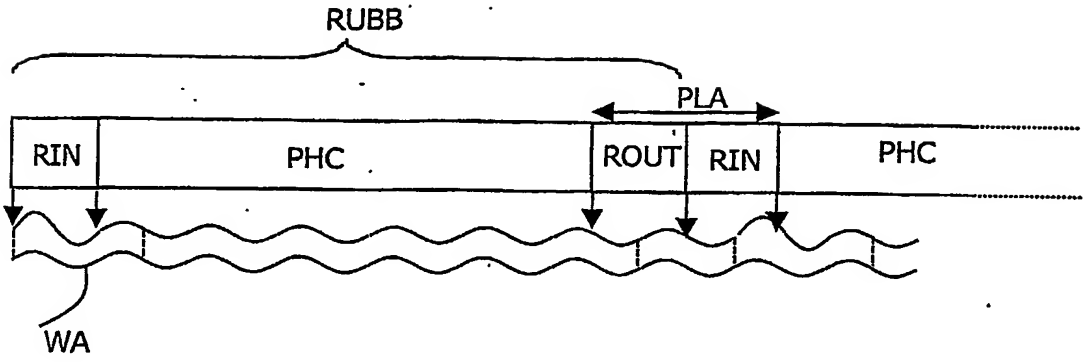

FIG.3

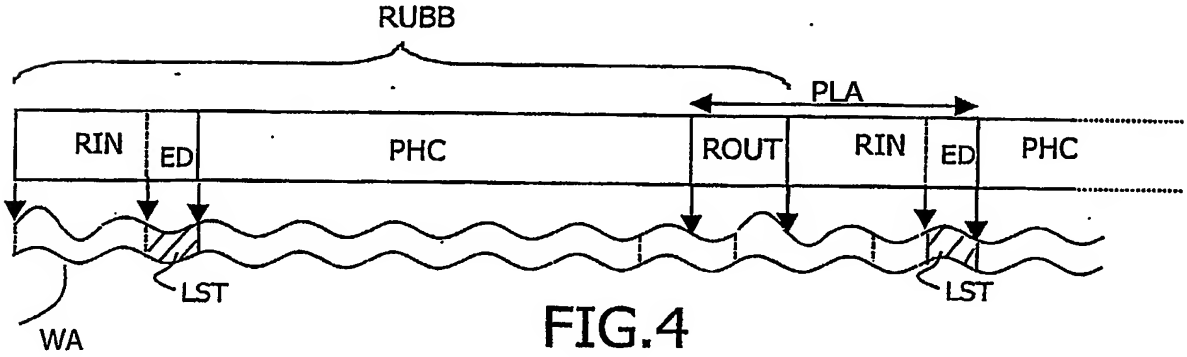

FIG.4

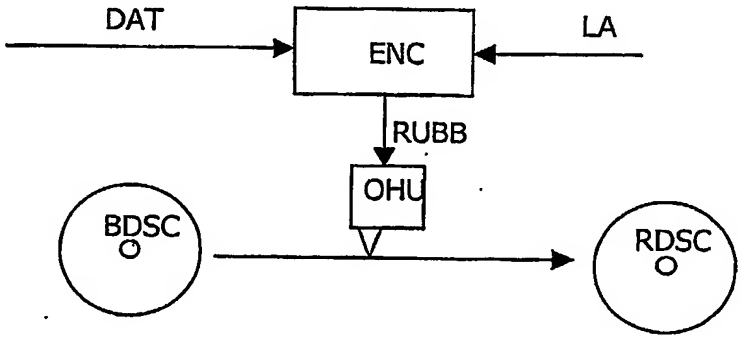

FIG.5

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